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# Pteridicolous ascomycetes from a cloud forest in eastern Mexico

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Abstract—Twenty-one ascomycetous taxa collected on ferns in a cloud forest of Veracruz, Mexico are reported and described. Fourteen represent new records for the Mexican mycobiota: *Bisporella pteridicola*, *Crocicreas quinqueseptatum*, *Dasyscyphella dryina, Durella macrospora, Hamatocanthoscypha helicotricha, Hyaloscypha fuckelii*, *Lachnum brevipilosum*, *L. nudipes*, *Mollisia ventosa, Orbilia auricolor, Protocreopsis pertusa, Seimatosporium tostum*, *Stictis carnea*, and *S. radiata*. Two collections—*Cyathicula* and cf. *Arachnopeziza*—that could not be fully identified may represent new species. The remaining five taxa have previous Mexican records but are reported here from new fern hosts. This study increases to 25 the number of ascomycete species known to occur on ferns in the cloud forests of Mexico.

Key words—*Cyatheaceae, Helotiales, Hypocreales, Ostropales, Xylariales*

## Introduction

The *Ascomycota*, with around 90,000 species (Cannon & al. 2018), is the most diverse group in kingdom *Fungi*. Its diversity significantly complicates gaining knowledge of individual species, especially those with minute fruitbodies restricted to specialized substrates. Such is the case of fungi growing on ferns. Most fungi reported on ferns are saprobes, a group that

receives less attention than parasites (Mehltreter et al. 2010). Currently 69 ascomycete species have been recorded in cloud forest of Veracruz (Medel 2013), small in comparison to the over 500 fern species known to inhabit cloud forests (Tejero-Díez & al. 2011). Although the first fern-related fungal study was devoted to rust fungi (Stevenson 1945), subsequent studies have been more focused on ascomycetes and their anamorphs (e.g., *Mycosphaerellaceae* and *Periconiella;* Braun 2004, Kirschner & Liu 2014). Other studies have centered on endophytic ascomycetes and fern-associated saprobes (Cannon 1997, Castañeda-Ruiz & Heredia 2000, Del Olmo & Arnolds 2014, Dingley 1972, Medel & Lorea-Hernández 2008, Samuels & Rogerson 1990).

For Mexico there are relatively few studies on the diversity of fern-inhabiting fungi (Castañeda-Ruiz & Heredia 2000, Haines 1980, Medel & Lorea-Hernández 2008, Medel & al. 2010, Samuels & Rogerson 1990). So far, the seven ascomycete species recorded growing on ferns represent only three genera: *Crocicreas* Fr. (1), *Dimeriella* Speg. (1), and *Lachnum* Retz. (5). The few *Ascomycota* recorded from these forests contrasting with the great diversity of fern species suggests a high diversity yet to be explored. The present study was conducted in order to provide more information about the diversity of fern-inhabiting fungi in Mexican cloud forests.

## Materials & methods

Sampling sites in central Veracruz state (eastern Mexico) were selected based on the high fern diversity within an area. Three sampling sites were chosen: El Riachuelo, Los Encinales, and Río Xocoyolapan. Field work was conducted during August–November 2011. Fungi were collected by opportunistic sampling of different fern species, with fronds and rachises presenting ascomata or stromata selected and placed in paper bags (Mueller & al. 2004).

Fruiting bodies were identified and processed following standard mycological techniques for *Ascomycota* (Dennis 1978). Specimens were hand sectioned, pretreated with 3% aqueous KOH, and stained with phloxine and Melzer's reagent; ascal tip bluing reactions are designated by J– (negative, no blue present) and J+ (positive, blue present). Tissues were examined microscopically using a Zeiss Primo Star microscope. Averages, ranges, and Q-calculations (Largent & al. 1977) are based on 30 measurements. Colours are coded according to Kornerup & Wanscher (1978). Ascomata were photographed digitally with a Sony Cyber-Shot camera mounted on a Zeiss Stemi DV4 stereomicroscope. The specimens were identified using specialized literature (Breitenbach & Kränzlin 1984, Carpenter 1981, Dennis 1949, 1956, 1960, 1978). Fungal nomenclature follows Index Fungorum (2019), and host plants were identified following Mickel & Smith (2004). All specimens are

deposited in the mycological collection of the Herbarium, Instituto de Ecología A.C. (XAL). Specimens discovered in XAL and also examined are noted as "additional specimens examined" in species descriptions where pertinent.

## Taxonomy

### cf. *Arachnopeziza* Figs 1–3

Apothecia sessile, cup-shaped, reddish-golden (6C7) to Pompeian yellow (5C6), ≤1 mm diam., margin hairy (sparsely pilose), hairs white (1A1), readily dropping from the margin to give a smooth appearance. Subiculum white to pale yellowish white (1A1, 2A1), not scattered on the substrate, reticulate or net-like, with hyphae 2–3 µm diam., septate, hyaline, thick-walled (≤1 µm). Asci cylindrical, 70–90(–100) × 7–9(–10) µm, thin-walled, hyaline, 1–2-seriate, pore J+. Ascospores cylindrical-ellipsoid, (13–)14–15 × 5 µm (Q = 2.8), smooth, hyaline, 0–1-septate, biguttulate, with sheath and hyaline appendages observed in Cresyl blue. Paraphyses filiform, 1–2 µm diam., hyaline, septate toward the base. Ectal Excipulum a textura globulosa to textura angularis, cells 12–25(–40) µm diam.

Habitat—Gregarious, on rachises of *Alsophila firma*. Known only from these collections.

Specimens examined—**MEXICO**. **Veracruz**: **San Andrés Tlalnelhuayocan County**, Río Xocoyolapan, 19°30.89′N 97°00.39′W, 1590 m, 13 October 2011, Córdova 78.

Additional specimens examined: **MEXICO. Veracruz: San Andrés Tlalnelhuayocan County**, Rancho Agüita Fría, 6 April 2007, Medel 1362; 1363-A.

*Arachnopeziza* Fuckel is characterized by small apothecia growing on a densely reticulate, net-like subiculum covered by hairs, and ellipsoid-fusoid to filiform, 1–7-septate ascospores (Korf 1951). The genus has a worldwide temperate distribution but is uncommon in the tropics (Gamundí & Giaiotti 1994). Although the studied specimens suggest an affinity with *Arachnopezizaceae,* they do not match any known genus or species covered in the references consulted (Dennis 1949, Huhtinen 1987, Korf 1951). The 0–1-septate spores covered by a hyaline sheath with a small appendage resemble those of *Arachnopeziza aurelia* (Pers.) Fuckel, which differs in its long hairs, slightly larger spores (17–22 × 3.5–5.5 µm, 0–3-septate; Korf 1951). The presence on the apothecial margin of very thick, scarce, and septate hairs that drop off, leaving a smooth margin (as in our specimen; Fig. 1) is a feature unknown in *Arachnopeziza.* The subiculum is restricted to the apothecial base and not distributed throughout the substrate, unusual in *Arachnopeziza* (Seaver 1938), but not uncommon in *Parachnopeziza* Korf.

In *Parachnopeziza,* however, apothecia grow directly from a small stipe immersed in the substrate (Korf 1978) growing directly from a subiculum, as occurs in *Arachnopeziza*, and certainly in our specimen.

***Bisporella pteridicola*** F. Ren & W.Y. Zhuang,
Mycosystema 36 (4): 408 (2017). Figs 4, 5

Apothecia superficial, cup-shaped to discoid. Disc concave, yellow (4A6), pastel yellow (2A4), or chicken yellow (2A6), translucent, waxy in appearance, 0.2–0.4 mm diam. Stipe short or absent, concolorous with the disc. Asci claviform (32–)35–40(–45) × 5–6 µm, 8-spored, biseriate, apical pore J–, arising from croziers. Ascospores fusiform (5 –)8–9(–10) × 2–3 µm (Q = 4.3), hyaline, with two oil drops and one septum visible in KOH. Paraphyses filiform, slightly enlarged at the apex, 1.5–2 µm diam. Ectal Excipulum a textura angularis, gelatinized, 15–40 µm thick, cells 3–6 µm diam., protruding from outer surface ≤3 µm. Medullary Excipulum a textura intricata, thin, hyaline, not gelatinized, cells 2–3 µm diam.

Habitat—On rachises of unidentified fern as well as on fern rachises and leaf blades of *Alsophila firma, Cyathea bicrenata*, *Sphaeropteris horrida*, *Pecluma alfredii*, and *Thelypteris* sp.

Specimens examined—**MEXICO**. **Veracruz**: **San Andrés Tlalnelhuayocan County**, **Río Xocoyolapan,** 19°30.89′N 97°00.39′W, 1590 m, 13 October 2011, Córdova 80c; 4 November 2011, Castillo del Moral 63, 66; 8 December 2011, Medel & Lorea 2203. El Riachuelo; 19°30.99′N 97°00.39′W, 1626 m, 18 August 2011, Baeza 47a, Córdova 67, 71; 11 November 2011, Medel 2192. Los Encinales, 19°31.10′N 97°00.32′W, 1630 m, 10 August 2011, Baeza 36; 18 August 2011, Baeza 49,55, 57; Medel & Lorea 2158, Córdova 73, 74.

*Bisporella* Sacc. is a genus easily recognized by its small sessile bright yellow apothecia growing on woody substrata (Carpenter & Dumont 1978a, Dumont 1981). *Bisporella pteridicola* was described growing on ferns in Asia (Zhuang & al. 2017). Ours is the first report of the species from Mexico. Our collections agree with the description in Zhuang & al. (2017) in color, size, and shape of the apothecia, ascospore measurements, and ecology (growth on ferns).

***Coenogonium botryosum*** C. Knight,
Syn. Queensl. Fl. 1(Suppl.): 74 (1886). Figs 6, 7

Apothecia superficial, discoid, sessile, flattened, 0.5–1 mm diam., pale yellow (3A3), waxy in appearance, margin differentiated from the disc, smooth, yellowish white (3A2), paler than the disc. Thallus filamentous or felt-like and pilose, with short, upright algal threads resembling hairs,

greyish yellow to linden green (2B5-2C5). Hymenium J+. Hairs small and thin, linden green (2C5) to pale yellow (1A3-2A3), filiform, septate. Asci cylindric-clavate (48–)50–55(–60) × 4–5 µm, thin walled, uniseriate. Ascospores ellipsoid (7–)8–9(–12) × 2 µm (Q = 4.2), hyaline, smooth, 0–1-septate, with 4 small guttules. Paraphyses cylindrical, apices 4–5 µm diam., bifurcate, hyaline, septate. Ectal excipulum a textura globulosa, with hyaline cells.

Habitat—Gregarious, on fronds of *Adiantum andicola* and *Grammitis* sp.

Specimens examined—**MEXICO**. **Veracruz**: **San Andrés Tlalnelhuayocan County**, El Riachuelo, 19°30.99′N 97°00.39′W, 1626 m, 8 December 2011, Baeza 70, Medel & Lorea 2211, 2215.

*Coenogonium* Ehrenb. is a tropical and subtropical ascolichen genus found on all continents (GBIF 2019, Rivas-Plata & al. 2006, Uyenco 1963). The filamentous green-pale yellowish thallus attached to the substrate by small filaments as well as the threadlike algae, absence of septa, uniseriate asci, and paraphyses with capitate subglobose apices are characteristic of *C. botryosum* (Rivas-Plata & al. 2006). Two similar species are *C. moniliforme* Tuck., which has moniliform algae without septa, and *C. implexum* Nyl., which has bright yellow thalli and a cottony texture.

Known from Neotropics and eastern Paleotropics (GBIF 2019, Rivas-Plata & al, 2006, Uyenco 1963), *Coenogonium botryosum* was reported previously for Veracruz, Mexico, growing on *Ficus* (Uyenco 1963); this is the first report of the species on ferns.

***Crocicreas quinqueseptatum*** S.E. Carp.,
Mem. New York Bot. Gard. 33: 160 (1981). Figs 11, 12

Apothecia cup-shaped, 0.5–0.8 mm diam. Disc white to yellowish white (2A2, 2A1). Margin denticulate, inrolled over the hymenium when dry, almost hyaline or translucent with long teeth; teeth fragile, formed by groups of long, septate, hyaline hyphae, 100–115(–400 µm) × 40–48 µm, lighter in colour than the rest of the apothecium, white to yellowish white (2A1-2A2), 8–12 teeth per apothecium; breaking easily leaving the apothecia non-denticulate. Stipe cylindrical, thin, concolorous with apothecia. Asci cylindrical, tapering toward the base, (60–)80–105 × 6–8 µm, thin-walled, apical pore J+, biseriate, base without croziers. Ascospores fusoid to fusiform with subacute to acute ends, smooth, (20–)26–30 × 3–4 µm (Q = 5.5), 5-septate (rarely 6–7), hyaline. Paraphyses filiform, unbranched,

1–2 µm diam., hyaline. Ectal excipulum single layered, gelatinous, composed of long cells in the inner part, extending outward from the disc to form the teeth. Medullary excipulum not differentiated.

Habitat—On fallen stems and rachises of *Alsophila firma* and *Cyathea bicrenata*.

Specimen examined—**MEXICO**. **Veracruz**: **San Andrés Tlalnelhuayocan County**, Los Encinales, 19°31.10′N 97°00.32′W, 1630 m, 10 August 2011, Medel & Lorea 2168.

*Crocicreas quinqueseptatum* was described by Carpenter (1981) as having ascospores with a variable number (4–7) of septa and which are slightly longer and narrower [(28–)30–33(–35) × (2–)2.5–3 µm] than those found in our specimen. Other features (outer apothecial surface, morphology, and measurements) are close to *C. helios* var. *parahelios* S. E. Carp., which differs by 0–3-septate ascospores, an absent or poorly developed medullary excipulum, and broader apothecia (≤1.5 mm; Carpenter 1981). *Crocicreas quinqueseptatum* has been reported growing on angiosperm stems, especially fallen herbaceous stems of *Asteraceae* in South America. This is the first report of this species on ferns.

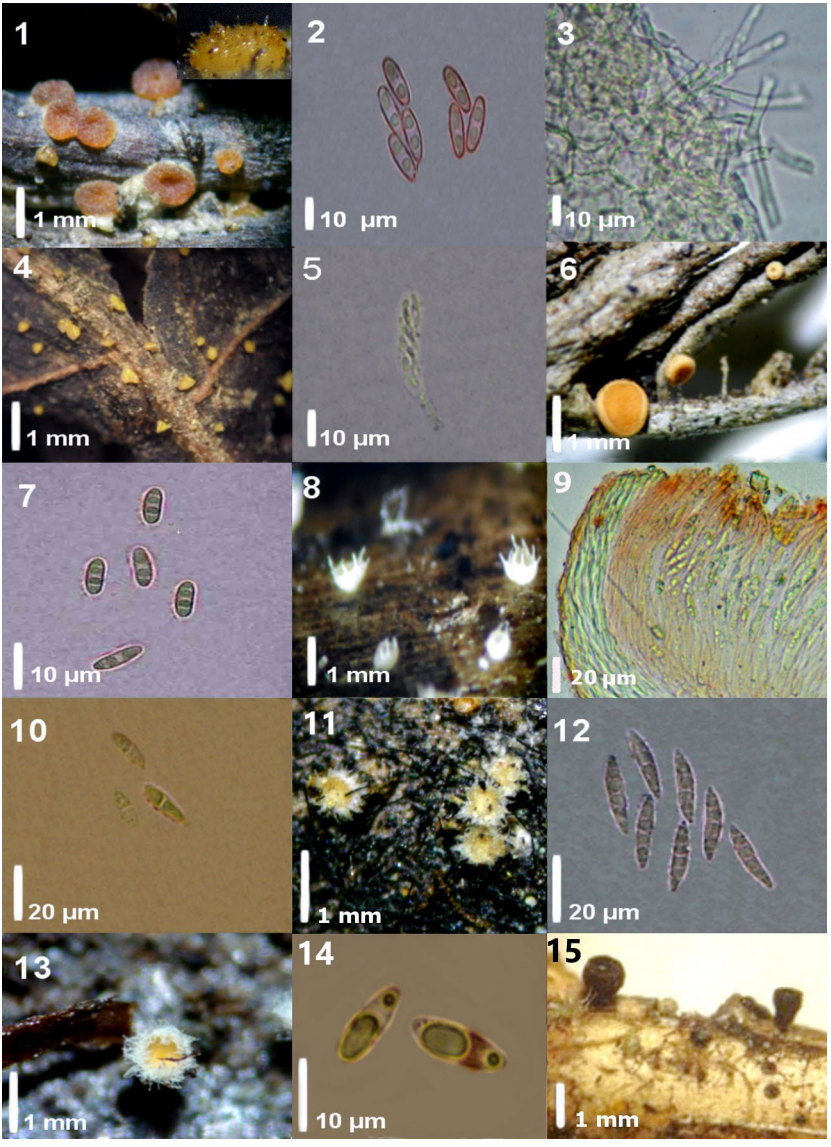
***Cyathicula* sp.** Figs 8–10

Apothecia cup-shaped, sessile, disc flattened or concave, ≤1 mm diam., pastel yellow (3A4); margin dentate with 6–10 hyaline teeth per ascoma, teeth composed of groups of long, hyaline, aseptate hyphae that extend beyond the margin, each tooth separated by c. 420–480 µm. Asci cylindric-clavate, (96–)110–140 × (7–9)10–11 µm, 8-spored, biseriate, apical pore J–. Ascospores ellipsoidal-fusiform, 13–16 × 5–6 µm (Q = 2.6), smooth, hyaline, 1–3-septate, guttulate. Paraphyses filiform, apices simple or branched, 2–3 µm diam. at apex, septate; embedded with asci in a gelatinous matrix and separated only with difficulty. Ectal excipulum a textura prismatica to textura porrecta, hyphae single-layered, long-celled, subparallel, close together, thick-walled, hyaline, smooth, lacking crystals. Medullar excipulum little differentiated, hyphae 3–5 µm diam., not easily observed due to gelatinous consistency.

Habitat—On rachises of *Cyathea bicrenata*. Known only from our collections.

Specimens examined—**MEXICO**. **Veracruz**: **San Andrés Tlalnelhuayocan County**; El Riachuelo, 19°30.99′N 97°00.39′W, 1626 m, 4 November 2011, *Baeza 56;* Los Encinales, 19°31.10′N 97°00.32′W, 1630 m, 13 October 2011, Baeza 56a; 4 November 2011, Baeza 61, Castillo del Moral 64.

We place our material into *Cyathicula* based on its cupulate, sessile apothecium with a toothed margin, whitish yellowish to pale brown color,




Figs 1–15. **cf.** ***Arachnopeziza.*** 1. Apothecia showing scarce subiculum and hairs (top right); 2. Ascospores in Congo red; 3. Excipulum showing hyphae from the subiculum. ***Bisporella pteridicola.*** 4. Apothecia; 5. Asci with ascospores. ***Coenogonium botryosum.*** 6. Apothecia; 7. Ascospores. ***Cyathicula*** **sp.**; 8. Apothecia; 9. Cross section of excipulum, 10. One-septate ascospores. ***Crocicreas quinqueseptatum.*** 11. Apothecia showing dentate margin; 12. Ascospores. ***Dasyscyphella dryina.*** 13. Apothecium; 14. Ascospores. ***Durella macrospora.*** 15. Apothecia.

septate ascospores, J– asci, and the presence of a gelatinous matrix (Carpenter & Dumont 1978b). Nonetheless, we must also note that the specimens fit diagnostic characters of *Crocicreas* (Carpenter 1981). The controversy over whether *Crocicreas* and *Cyathicula* are congeneric has lasted for decades (Iturriaga & al. 1999, Zheng & Zhuang 2016). According to one classification of *Helotiales* (Baral & al. 2015), *Crocicreas* is restricted only to the type species *C. gramineum* (Fr.) Fr., and *Cyathicula* is unrelated. Although Wijayawardene & al. (2018) support this distinction, we agree with the conclusion of Zheng & Zhuang (2016) that existing data are insufficient for determining the relationship between *Crocicreas* and *Cyathicula*. Molecular analysis is still needed for us to assign our material definitively to a genus.

***Dasyscyphella dryina*** (P. Karst.) Raitv.,
Akad. Nauk Estonskoi S.S.R., Inst. Zool. Bot., Tartu: 72 (1970). Figs 13, 14

Apothecia superficial, cup-shaped, stipitate, covered with white (1A1) hairs. Disc 0.8–1 mm diam., yellowish white (2A2) to pale yellow (2A3), smooth. Stipe cylindrical, covered with white (1A1) hairs with small hyaline crystals at the tips. Hairs cylindrical, septate, slightly granular, hyaline, easily visible, giving a distinctive villous appearance to the apothecium. Asci cylindrical, 45–50 × 3–4 µm, hyaline, 8-spored, irregularly biseriate, thin walled, apical pore J+. Ascospores cylindric-ellipsoid to fusoid, (6–)7–10 × 2–3 µm, (Q = 4.2), smooth, hyaline, with rounded ends. Paraphyses filiform, slightly lanceolate, 1 µm diam., hyaline, projecting beyond the asci by 10–20 µm.

Habitat—On rachises of *Alsophila firma*.

Specimens examined—**MEXICO**. **Veracruz**: **San Andrés Tlalnelhuayocan County**, Río Xocoyolapan, 19°30.89′N 97°00.39′W, 1590 m, 19 August 2011, Medel 2180, Medel 2181.

The studied specimen matches well with the concept of *Lachnum distinguendum* sensu Dennis (1949, 1956, 1960), which is a synonym of *Dasyscyphella dryina*. Dennis (1956) cited spores 2 µm longer than those of our collections, and filiform paraphyses which agreed with our specimen. Rick (1906) described *L. distinguendum* Rick with broader apothecia (≤2 mm diam.), larger asci (50–69 × 7–10 µm), larger ascospores (10–15 × 3–4 µm), and lanceolate paraphyses (3–4 µm diam.). Raitviir (1970) cited slightly longer ascospores (9–12 × 2–3.2 µm) and cylindrical paraphyses with pointed tips. Nonetheless, our collection fits better Dennis's concept, because our material has paraphyses that exceed the asci, while Raitviir (2002) described paraphyses not exceeding the asci.

*Dasyscyphella dryina* is known from Europe and South America on *Betula, Fagus,* and *Populus* (Dennis 1949, 1956. 1960, Raitviir 1970, Rick 1906).

***Durella macrospora*** Fuckel,
Jahrb. Nassauischen Vereins Naturk. 23–24: 281 (1870). Figs 15–17

Apothecia superficial, cup-shaped, stipe short with a wide base. Disc flat, 0.2–0.5 mm diam., wrinkled, brownish gray (10F2) with dark brown (7F8) tones, hard consistency. Asci cylindrical (90–)100–130 × 11–12 µm, hyaline, 8-spored, irregularly biseriate, apical pore J–. Ascospores ellipsoid-fusiform, (18–)19–22(–23) × 4–5 µm (Q = 4.2), smooth, hyaline, 3-septate, constrained at the septum, ends rounded, with 4 small guttules. Paraphyses cylindrical, slightly wider at the apex (c. 3 µm) brownish to reddish brown in KOH. Ectal excipulum of parallel brown hyphae.

Habitat—On fronds of *Sticherus palmatus.*

Specimen examined—**MEXICO. Veracruz: San Andrés Tlalnelhuayocan County**, El Riachuelo, 19°30.99′N 97°00.39′W, 1626 m, 8 December 2011, Medel 2210.

Spores of *Durella macrospora* have been cited as 15–21 × 3–5.5 µm (Breitenbach & Kränzlin 1984, Medardi 2004). Although the spores in our collection are 2 µm longer, other morphological characters (black apothecia, hard consistency, ectal excipulum of parallel brown hyphae) agree well with the published descriptions (Breitenbach & Kränzlin 1984, Medardi 2004).

*Durella macrospora* has been previously recorded growing on wood of deciduous trees such as *Fagus*, *Malus domestica,* and *Quercus* sp. (Breitenbach & Kränzlin 1981, Medardi 2004), but not on ferns. Previously known only from Europe (Breitenbach & Kränzlin 1984, Dennis 1956, Medardi 2004).

***Hamatocanthoscypha helicotricha*** Huhtinen,
Karstenia 29(2): 182 (1990 ["1989"]). Figs 18–20

Apothecia cup-shaped, disc concave, pale yellow (3A3) to pastel yellow (3A4) shades, 0.5 mm diam., covered with fine, white (1A1) to yellowish white (2A1-2A2) short hairs. Stipe cylindrical, short, slightly robust, concolorous with apothecia. Hairs cylindrical, apically coiled to uncinate, 12–32 × 2–4 µm, the apex tapering to ≤1 µm diam., hyaline, septate toward to the base, smooth. Asci cylindric-clavate, apex conical, base attenuate, (42–)45–72 × 6–7 µm, hyaline, pore J–, 8-spored, biseriate, base with croziers. Ascospores ellipsoid-fusoid, hyaline, smooth, 7–9(–10) × 2–3 µm (Q = 2.6), 1-septate, biguttulate. Paraphyses filiform, 2 µm diam., narrowing toward the base.

Habitat—On rachises of *Cyathea bicrenata* and fronds of *Sticherus palmatus*.

Specimens examined—**MEXICO**. **Veracruz**: **San Andrés Tlalnelhuayocan County**, El Riachuelo, 19°30.99′N 97°00.39′W, 1626 m, 8 December 2011, Medel & Lorea 2213. Los Encinales, 19°31.10′N 97°00.32′W, 1630 m, 10 August 2011, Baeza 41.

Huhtinen (1990) and Raitviir (2004) report somewhat larger (9.8–12.8 × 2.8–4 μm) spores than found in our specimens, but the presence of strongly coiled hairs at the apex distinguishes this species. *Hamatocanthoscypha helicotricha* has been recorded on fern rachises from Colombia and Cuba (Huhtinen 1990, Raitviir 2004); this is the first report of the species for Mexico.

***Hyaloscypha fuckelii*** Nannf.,
Nova Acta Regiae Soc. Sci. Upsal., Ser. 4, 8(2): 273 (1932). Figs 21, 22

Apothecium superficial, sessile, cup-shaped. Disc concave, 0.1–0.3 mm diam., white (1A1), translucent when fresh or when rehydrated in KOH. Receptacle with fine, whitish hairs. Hairs filiform, cylindrical, curved in the apex, thin-walled, slightly granular. Asci clavate, 50–66(–67) × 4–5 μm, hyaline, thin-walled, 8-spored, irregularly biseriate, apical pore J+, base with croziers. Ascospores ellipsoid, (5–)6–8(–10) × 2 μm, (Q = 3.2), 0–1-septate, smooth, hyaline, with small oil drops. Paraphyses filiform, protruding ≤9 μm beyond asci, narrow, smooth, hyaline, apical cell with small guttules.

Habitat—On rachises of *Alsophila firma*.

Specimen examined—**MEXICO**. **Veracruz**: **San Andrés Tlalnelhuayocan County**, El Riachuelo, 19°30.99′N 97°00.39′W, 1626 m,10 August 2011, Baeza 38.

Our collection agreed with *Hyaloscypha fuckelii* as described by Huhtinen (1990). The similar *H. albohyalina* (P. Karst.) Boud. differs in its narrow hairs and smaller spores.

*Hyaloscypha fuckelii* is widely distributed in Europe and North America (Huhtinen 1990) and has been reported growing on monocotyledonous genera such as *Juncus*, *Typha,* and *Molinia*. This is a new record for Mexico and the first report on ferns.

***Lachnum brevipilosum*** Baral,
Beih. Z. Mykol. 6: 74 (1985). Figs 23, 24

Apothecium superficial, cup-shaped. Disc concave, white (1A1) to pale (2A2), 0.8–1 mm diam. Receptacle covered with whitish hairs visible

to the naked eye. Stipe cylindrical, 0.6 mm long, covered by hairs generally concolorous with disc (white, 1A1) except for some with a yellowish gray (4B2) base. Hairs cylindrical, 130–150 × 4–5 µm (the apex tapering to ≤2–3 µm), 5–7-septate, hyaline, covered by granules. Asci clavate-cylindrical, 42–50 × 4–5 µm, hyaline, pore J+, 8-spored, biseriate, croziers not observed. Ascospores ellipsoid, smooth, with rounded ends, 8–10(–12) × 2 µm (Q 4.2), hyaline, 1-septate, biguttulate. Paraphyses filiform, septate, protruding by 5–10 µm above the asci, hyaline.

Habitat—On rachises of *Alsophila firma* and *Cyathea bicrenata.*

Specimens examined—**MEXICO**. **Veracruz**: **San Andrés Tlalnelhuayocan County**, Río Xocoyolapan, 19°30.89′N 97°00.39′W, 1590 m, 4 November 2011, Baeza 58. Paraje El Riachuelo, 19°30.99′N 97°00.39′W, 1626 m, 4 November 2011, Córdova 86.

The Mexican specimens agree with the morphology of *Lachnum brevipilosum* as provided by Dennis (1949, as *Dasyscyphus brevipilus* Le Gal) and Ye & al. (2006), except for the length and width of the hair apices.

*Lachnum brevipilosum* has been reported growing on stems of *Clematis, Fagus*, and *Rubus* from Europe and temperate China (Dennis 1949, Ye & al. 2006) This is a new record for Mexico and represents the first report on ferns.

***Lachnum nudipes*** (Fuckel) Nannf.,
Svensk Bot. Tidskr. 22: 124 (1928). Figs 25, 26

Apothecium superficial, cup shaped. Disc concave slightly flattened, yellowish white (4A2) to pale yellow (4A3), 0.3–0.4 mm in diameter. Receptacle densely covered with white (1A1) hairs. Stipe cylindrical, with whitish hairs (1A1), more or less equal to the diameter of the disc. Hairs cylindrical, ornamented with granules, widening at apex to 3–4 µm, longer than 80 µm, hyaline in KOH. Asci clavate, (35–)38–47 × 4–5 µm, 8-spored, biseriate, pore J+, base without croziers. Ascospores fusiform to elliptical with rounded ends, (5–)6–8(–9) × 1–2(–3) µm (Q = 3.1), smooth, hyaline. Paraphyses lanceolate, septate towards the base, (50–)68–70 × 3–4 µm, clearly extending beyond the asci.

Habitat—On fronds of *Lophosoria quadripinnata*.

Specimens examined—**MEXICO**. **Veracruz**: **San Andrés Tlalnelhuayocan County**, Río Xocoyolapan 19°30.89′N 97°00.39′W, 1500 m, 18 August 2011, Córdova 72, 13 October 2011, Baeza 51; 4 November 2011, Córdova 65, 84, Castillo del Moral 65.

Our material agrees with Dennis's (1949) descriptions of *Dasyscypha nudipes* (Fuckel) Sacc. var. *nudipes* and *D. nudipes* var. *minor* Dennis [both now treated

as synonyms of *L. nudipes*], but our ascomata and ascospore measurements are closer to his *D. nudipes* var. *minor*.

*Lachnum nudipes* has been reported on *Epilobium, Filipendula,* and *Spiraea* in Europe (Dennis 1949, as *Dasyscypha*). This is the first record *Lachnum nudipes* for Mexico and the first report of its occurrence on ferns.

***Lachnum pteridophyllum*** (Rodway) Spooner,
Biblioth. Mycol. 116: 470 (1987). Figs 27, 28

Macro and micromorphological characters agree with the description of Medel & Lorea-Hernández (2008).

Habitat—On rachises of *Cyathea divergens* var. *tuerckheimii, Cyathea* sp., *Dryopteris* sp., and *Lophosoria quadripinnata*.

Specimens examined—**MEXICO**. **Veracruz**, **San Andrés Tlalnelhuayocan County**, El Riachuelo, 13 October 2011, Baeza 29, 52, 53; 4 November 2011, Baeza 60, Medel 2196; 8 December 2011, Medel & Lorea 2214. Los Encinales, 19°31.10′N 97°00.32′W, 1630 m, 10 August 2011, Baeza 36. 19 August 2011, Medel 2179, 2182, 2185.

*Lachnum pteridophyllum* has been reported from Colombia, Dominican Republic, Jamaica, Mexico, Panama, Peru, Puerto Rico, New Guinea, New Zealand, Taiwan, Tasmania, and Venezuela (Haines 1980, Medel & Lorea-Hernández 2008). Haines (1980) cited this species on *Cyathea sp.* from Oaxaca (Mexico), and Medel & Lorea-Hernández (2008) from Veracruz on decaying leaves of *Dicksonia sellowiana, Cyathea divergens* var. *tuerckheimii,* and *Cyathea* spp. We add now two more hosts: *Dryopteris* sp. and *Lophosoria quadripinnata*.

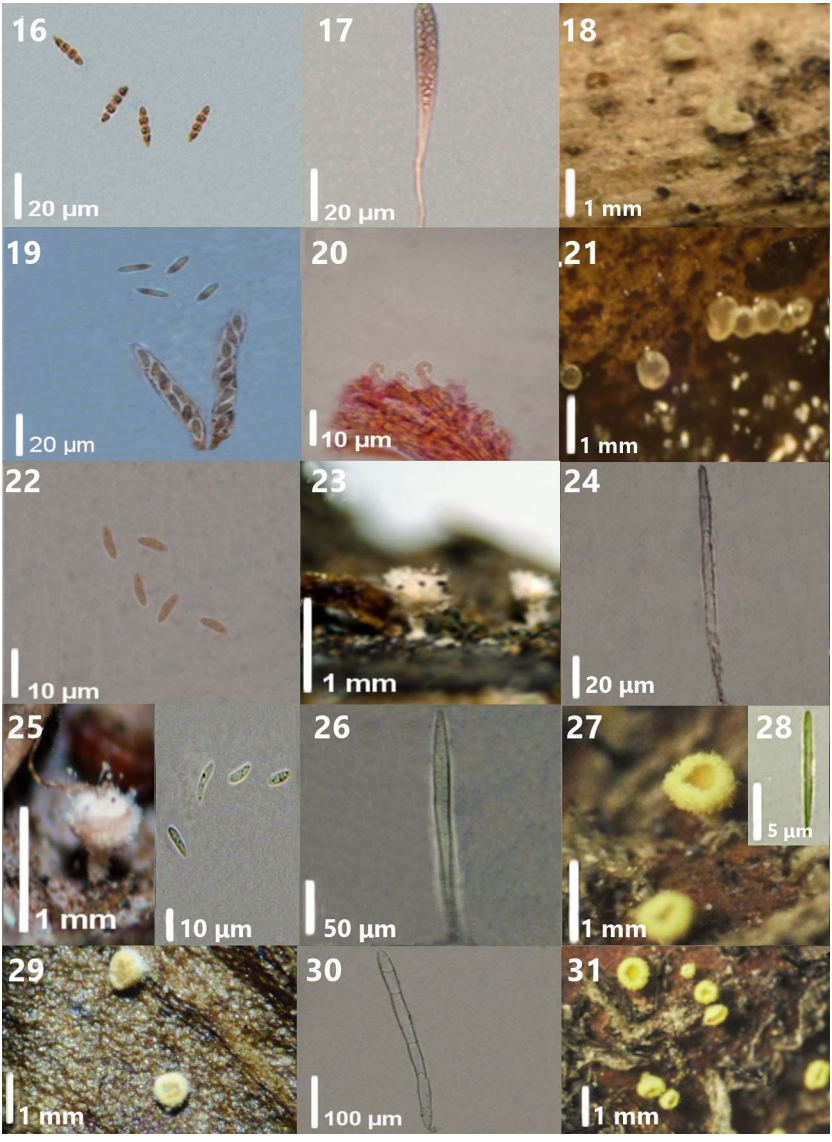
***Lachnum singerianum*** (Dennis) W.Y. Zhuang & Zheng Wang,
Mycotaxon 67: 27 (1998). Figs 29, 30

Macro and micromorphological characters agree with the description of Medel & Lorea-Hernández (2008).

Habitat—On rachises of *Alsophila firma* and *Dicksonia sellowiana.*

Specimen examined—**MEXICO**. **Veracruz**: **San Andrés Tlalnelhuayocan County**, Río Xocoyolapan, 19°30.89′N 97°00.39′W, 1590 m; 8 December 2011, Medel 2222.

*Lachnum singerianum* is known from the Andean region in South America from Bolivia to Venezuela and from China, Jamaica, and Mexico (Haines 1980, Medel & Lorea-Hernández 2008). Haines (1980) earlier reported *L. singerianum* growing on rachises of ferns, while Medel & Lorea-Hernández (2008) reported the species on decaying leaves of *Alsophila firma* and *Dicksonia sellowiana* in Veracruz.




Figs 16–31. ***Durella macrospora.*** 16. Three-septate ascospores; 17. Asci with 1-septate ascospores. ***Hamatocanthoscypha helicotricha.*** 18. Apothecia; 19. Asci and ascospores; 20. Uncinate or coiled hairs. ***Hyaloscypha fuckelii.*** 21. Apothecia; 22. Ascospores. ***Lachnum brevipilosum.*** 23. Apothecium; 24. Septate hairs. ***Lachnum nudipes.*** 25. Apothecium (left) and ascospores (right); 26. Lanceolate paraphysis. ***Lachnum pteridophyllum.*** 27. Apothecium; 28. Ascospores. ***Lachnum singerianum.*** 29. Apothecium; 30. Septate hair in 5% KOH. ***Lachnum varians.*** 31. Apothecia.

***Lachnum varians*** (Rehm) M.P. Sharma,
Nova Hedwigia 43: 411 (1986). Figs 31, 32

Macro and micromorphological characters agree with the description of Medel & Lorea-Hernández (2008).

Habitat—On rachises of *Cyathea bicrenata* and *C. divergens* var. *tuerckheimii* and fronds of *Adiantum andicola.*

Specimens examined—**MEXICO. Veracruz: San Andrés Tlalnelhuayocan County**, El Riachuelo, 19°30.99′N 97°00.39′W, 1626 m 18 August 2011, Baeza 47b, Córdova 68, 69; 8 December 2011, Baeza 70.

Additional specimens examined: **MEXICO. Veracruz: Xalapa County,** Santuario del Bosque de Niebla, Parque Ecológico Francisco Javier Clavijero, 1 September 2013, Medel & Lorea 2259.

*Lachnum varians* is known from Australia, Hawaii, Mexico, New Guinea, New Zealand, South America, and the Caribbean (Haines 1980, Medel & Lorea-Hernández 2008). The species was previously reported only on decaying leaves of *Alsophila firma* (Medel & Lorea-Hernández 2008); the present study adds the new hosts *Cyathea bicrenata, C. divergens* var. *tuerckheimii,* and *Adiantum andicola.*

***Lachnum virgineum*** (Batsch) P. Karst.,
Bidrag Kännedom Finlands Natur Folk 19: 169 (1871). Figs 33, 34

Apothecia superficial, cupulate, 1–1.3 mm diam. Disc flat to concave, white to yellowish white (1A1-1A2). Receptacle densely covered with short, broad, white (1A1) hairs. Stipe, thin, covered with hairs concolorous with the apothecia. Hairs cylindrical, 60 × 5–6(–8) µm, granulose along the entire length, 3–4-septate, the apex broadening ≤8 µm diam. Asci cylindric-clavate, 42–51× 4–5 µm, 8-spored, biseriate, pore weakly blue (J+). Ascospores fusiform, ends rounded, with one end sometimes wider than the other, (6–)7–8 × 1–2 µm (Q = 4.6). Paraphyses lanceolate 4–5 µm diam., 2–3-septate, with small refractive guttules in the apex, extending beyond the asci by 20 µm.

Habitat—On fronds of *Phlebodium aureum.*

Specimens examined—**MEXICO. Veracruz: San Andrés Tlalnelhuayocan County**, El Riachuelo, 10 August 2011, Baeza 32; 8 December 2011, Medel 2208.

The Mexican specimens fit well the description of *Lachnum virgineum* (Spooner 1987), especially the shape, color, and size of the apothecium (densely covered by white hairs), spore size, and paraphyses exceeding the asci by 15–20 µm. *Lachnum virgineum* is similar to *L. controversum* (Cooke) Rehm, which differs in obtuse or slightly swollen hair apexes and very slightly

narrower (3.5–4.5 µm diam.) paraphyses. Although *L. virgineum* is generally regarded as lignicolous, we found it growing on fronds of *Phlebodium aureum*. Known from Australia and Europe (Breitenbach & Kränzlin 1984, Spooner 1987).

***Mollisia ventosa*** P. Karst.,
Bidrag Kännedom Finlands Natur Folk 19: 188 (1871). Figs 35–37

Apothecia superficial, sessile, discoid, flat, 0.5–1 mm diam., greenish-yellow (1A7) with dark grey (1F1) to olive gray (1D2) margin. Receptacle greenish gray (29F2), smooth. Asci (72–)85–115 × 7–8(–10) µm, apical pore J+. Ascospores ellipsoid, (9–)12–15(–16) × 1.5–2 µm (Q = 7.5), 1–3-septate, guttulate. Paraphyses filiform, slender, septate, branched or not. Ectal excipulum a textura angularis to textura globulosa, cells thick-walled, brownish, 6–10(–12) × 6–10 µm.

Habitat—On rachises of *Cyathea bicrenata*.

Specimens examined—**MEXICO**. **Veracruz**: **San Andrés Tlalnelhuayocan County**, El Riachuelo, 19°30.99′N 97°00.39′W, 1626 m, 4 November 2011, Medel 2196; 8 December 2011, Baeza 71, Baeza 72.

*Mollisia ventosa* has been reported from Europe, and America (Breitenbach & Kränzlin 1984, Dennis 1950, 1978, Medel & Chacón 1997). Dennis (1950, 1978) described *M. ventosa* with spores larger (10–20 × 2–3.5 µm) than those in our Mexican collections, which instead match the measurements cited by Breitenbach & Kränzlin (1984). They cited *M. ventosa* as growing on *Alnus* and decorticated wood, but not on ferns. *Mollisia undulatodepressula* (Feltgen) Le Gal & F. Mangenot, the only other *Mollisia* species known to inhabit cloud forests in Mexico, grows on rotten wood (Medel & Chacón 1997).

***Orbilia auricolor*** (A. Bloxam) Sacc.,
Syll. Fung. 8: 625 (1889). Figs 38, 39

Apothecia superficial, scattered, sessile, cup-shaped. Disc concave, 0.8–1 mm diam., yellow brownish to yellow gray (4B3-4B5) translucent when rehydrated, margin crenulate. Receptacle concolorous with disc, smooth. Asci cylindric-clavate, 30–40(–42) × 2–4 µm, hyaline, thin-walled, 8-spored, biseriate, pore J–, base forked. Ascospores curved-filiform, (8–)9–10 × 1 µm (Q = 8.8), smooth, hyaline. Paraphyses cylindrical, apex capitate, with incrustations, 3–4 µm diam., septate, branched at base. Ectal excipulum textura globulosa with hyaline cells.

Habitat—On rachises of *Cyathea bicrenata* and *Marattia laxa*.

Specimens examined—**MEXICO**. **Veracruz**: **San Andrés Tlalnelhuayocan County**, Río Xocoyolapan 19°30.89′N 97°00.39′W, 1590 m, 8 December 2011, Baeza 67, Medel 2202.

The morphology of the apothecia, ascospores, asci, and paraphyses in our Mexican specimens agree with *Orbilia auricolor* as described by Spooner (1987) and Mo & al. (2005). The asexual stage of *O. auricolor* has been recorded (as *Arthrobotrys oligospora* Fresen.*)* from Xochimilco, Mexico (Chavarria & al. 2010).

*Orbilia auricolor* is known from Asia, Australia, Europe (Breitenbach & Kränzlin 1984, Dennis 1981, GBIF 2019, Mo & al. 2005, Spooner 1987). The species has previously been recorded growing on dead wood and woody stems and other plant matter (Spooner 1987, Mo & al. 2005), but not on ferns.

***Protocreopsis pertusa*** (Pat.) Samuels & Rossman, Stud. Mycol. 42: 66 (1999). Figs 40, 41

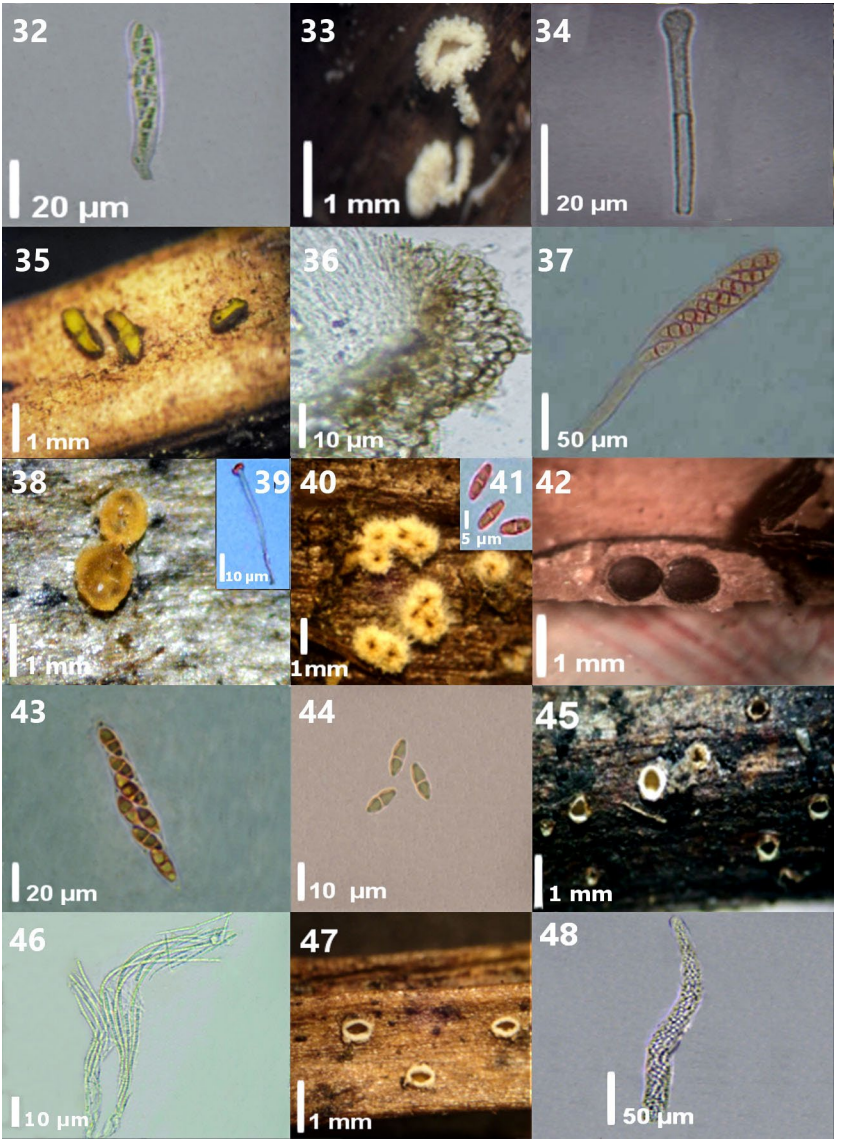
Perithecia aggregated, globose, sessile, 0.8–1 mm diam., covered by whitish (2A1) to yellowish white (3A2) hairs. Hairs cylindrical, curved to wavy, smooth, thick-walled, hyaline, apices simple or forked, septate. Subiculum of thin whitish (2A1) hyphae, attached to the perithecia. Asci clavate-cylindrical, 75–95(–100) × 10–12 µm, thin-walled, hyaline, ascospores irregularly biseriate, 8–spored, base with croziers. Ascospores ellipsoid, (13–)14–16 × 5 µm (Q = 2.7), smooth, hyaline, 1-septate, with two large guttules in the ends. Paraphyses filiform and hyaline.

Habitat—On rachises of *Alsophila firma* and *Marattia laxa*.

Specimens examined—**MEXICO**. **Veracruz**: **San Andrés Tlalnelhuayocan County**, Río Xocoyolapan, 19°30.89′N 97°00.39′W, 1590 m, 13 October 2011, Córdova 77; 8 December 2011, Baeza 68, Medel & Lorea 2205.

Additional specimens examined: **MEXICO. Veracruz: San Andrés Tlalnelhuayocan County,** Rancho Agüita Fria, 6 April 2007, Medel 1362.

Rossman & al. (1999) and Chaverri & al. (2010) described *Protocreopsis pertusa* as having thin white mycelium beneath each perithecium, thick-walled hairs densely united around the perithecial opening, and 1–3-septate spores measuring 13–17 × 4–5 µm, all characters agreeing with our Mexican specimens. This species has been reported from tropical to subtropical regions on leaves of *Musa*, *Heliconia*, palms, bamboos, and fern rachises. It is a new record for Mexico.




Figs 32–48. ***Lachnum varians.*** 32. Asci with ascospores. ***Lachnum virgineum.*** 33. Apothecia; 34. Hair with enlarged apex. ***Mollisia ventosa.*** 35. Apothecia; 36. Excipulum at margin and lower flank; 37. Asci with ascospores. ***Orbilia auricolor.*** 38. Apothecia 39. Paraphysis. ***Protocreopsis pertusa.*** 40. Apothecia 41. Ascospores. ***Seimatosporium tostum.*** 42. Stromata 43. Asci with ascospores, 44. Ascospores. ***Stictis carnea.*** 45. Apothecia. 46. Ascospores. ***Stictis radiata.*** 47. Apothecia; 48. Asci and ascospores.

***Seimatosporium tostum*** (Berk. & Broome) Rossman & W.C. Allen, IMA Fungus 7(1): 5 (2016). Figs 42–44

Stromata shield-like, growing within host tissue, black, grey (30F1) to greenish grey (30F2) pigments are observed in KOH. Two perithecia per stroma. Asci cylindrical, 62–75 × 5–7(–8) μm, thin-walled, apical pore J+, spores 1–2-seriate, without croziers. Ascospores ellipsoidal-fusiform, 1-septate, constricted at the septum, smooth, poles subacute to acute, (9–)10–11(–12) × 3–4 μm (Q = 2.3). Paraphyses filiform, ≤1 μm diam., extending beyond the ascus by 3–5 μm, with tiny hyaline guttules at the apex.

Habitat—On rachises of *Alsophila firma* and *Cyathea bicrenata.*

Specimens examined—**MEXICO. Veracruz: San Andrés Tlalnelhuayocan County**, Río Xocoyolapan, 19°30.89′N 97°00.39′W, 1590 m, 8 December 2011, Medel & Lorea 2108; 26 February 2001, Medel & Lorea 2201; Los Encinales, 19°31.10′N 97°00.32′W, 1630 m, 30 March 2014, Medel & Lorea 2379.

Additional specimens examined: **MEXICO. Veracruz: San Andrés Tlalnelhuayocan,** Rancho Agüita Fría, 7 February 2007, Medel 1342.

*Seimatosporium tostum* is described by Paulus & al. (2006) as having larger (>14 × 5 μm) hyaline ascospores with only one septum, while Brockmann (1976) described North American material (as *Discostroma tostum*) with 1–6-septate ascospores. The species has been reported growing on stems of *Epilobium*. Known from North America (Brockmann 1976, Paulus & al. 2006), *S. tostum* establishes a new record for Mexico and the first report on ferns.

***Stictis carnea*** Seaver & Waterston, Mycologia 33: 311 (1941). Figs 45, 46

Apothecia immersed in host tissue, hymenium greyish yellow to light yellow (1A5-1B6), 05–0.7 mm diam., surrounded by an elliptical white (1A1) ring. Asci cylindric-clavate, 110–150 × 6–7 μm, 8-spored, hyaline, J–. Ascospores long filiform, (80–)85–130(–150) × 3 $\mu$m, tapering to one end, multi-septate, twisted within the ascus. Paraphyses filiform, ≤3 μm wide, longer, hyaline, septate.

Habitat—On rachises of *Cyathea bicrenata.*

Specimen examined—**MEXICO. Veracruz: San Andrés Tlalnelhuayocan County**; Río Xocoyolapan; 19°30.89′N 97°00.39′W, 1590 m, 4 November 2011, Medel 2112.

There are two species of *Stictis* growing on ferns in our study site, *S. carnea* and *S. radiata.* The differences in spore length and apothecial morphology of the apothecia are sufficient to separate these two species (Sherwood 1977,

Johnston 1983). *Stictis carnea* has been reported from Asia, North America (including Mexico), and New Zealand (Johnston 1983, Sherwood 1977), growing on dead tissues of many herbaceous and woody plants and the fern *Cyathea medullaris* (Johnston 1983). This species is a new report from Mexico.

***Stictis radiata*** (L.) Pers., Observ. Mycol. 2: 73 (1800 ["1799"]). Figs 47, 48

Apothecia deeply sunken in host tissue, hymenium vivid yellow to yellow (3A7-3A8), ≤1 mm diam., surrounded by an irregular white (1A1) ring. Asci cylindric-clavate, 240–290 × (7–)10–12 µm, 8-spored, hyaline, narrowed toward the apex, pore J–. Ascospores long filiform, (219–)245–280(–283) × 2–3 $\mu$m, multiseptate, spirally arranged within the ascus. Paraphyses filiform, 1 µm diam., slightly widening (≤2 µm) at the apex.

Habitat—On rachises of *Alsophila firma, Cyathea bicrenata, Sphaeropteris horrida,* and fronds of *Polypodium* sp.

Specimens examined—**MEXICO**. **Veracruz**: **San Andrés Tlalnelhuayocan County**; Río Xocoyolapan; 19°30.89′N 97°00.39′W, 1590 m, 4 November 2011, Medel 2199; 8 December 2011, Baeza 69, Medel & Lorea 2200. Paraje El Riachuelo, 8 December 2011; Medel & Lorea 2207. Los Encinales, 19°31.10′N 97°00.32′W, 1630 m, 10 August 2011, Baeza 38b, Medel & Lorea 2169.

Diagnostic characters of *Stictis radiata* include ascomata with a deeply sunken orange yellow hymenium and filiform multiseptate spores with interlaced arrangement within the ascus and variably sized (180–325 × 1.9–2.8(–3) µm; Breitenbach & Kränzlin 1984, Johnston 1983, Sherwood 1977). *Stictis radiata* resembles *S. carnea* but is distinguished by its shorter and wider ascospores. Known from Mexico, New Zealand, and Australia (Johnston 1983, Sherwood 1977). In New Zealand, *S. radiata* has been reported on the ferns *Cyathea dealbata* and *Dicksonia squarrosa* (Johnston 1983). We found *S. radiata* also growing on *Sphaeropteris horrida* and *Polypodium* sp.

## Discussion

Ferns, which comprise many genera and families, serve as habitat for a large number of fungi. Our study indicates that most of the fungi on ferns belong to *Lachnaceae* [previously included in *Hyaloscyphaceae* s.l.], represented by eight species of *Lachnum*. Haines (1980), Samuels & Rogerson (1980), and Medel & Lorea-Hernández (2008) previously reported *Hyaloscyphaceae* s.l. on ferns. Medel (2013), who conducted earlier research on Mexican cloud forest ascomycetes, pointed out that *Lachnaceae* is "recurrent" on ferns in *Cyatheaceae,* indicating that some of these fungi may live as endophytes in this fern family.

The dominant plant associates in this study belong to the "tree ferns"—*Alsophila firma, Cyathea bicrenata*, *C. divergens* var. *tuerckheimii*, and *Sphaeropteris horrida*. Herbaceous fern species with short stems at or barely above ground level include *Dryopteris* sp., *Lophosoria quadripinnata*, *Marattia laxa*, and *Thelypteris* spp. *Adiantum andicola* and *Sticherus palmatus* are classed as herbs with underground stems, while *Grammitis* sp., *Phlebodium aureum, Pecluma alfredii*, and *Polypodium* sp., represent a diverse epiphytic fern group. Two fern species hosted the highest number of fungal species: *Alsophila firma* (11 species) and *Cyathea bicrenata* (12 species). The ascomycetes identified in this study grew more frequently on petioles and rachises of tree ferns and some herbaceous ferns.

Our work stresses the importance of studying the highly diverse small ascomycetes given that new records have been established by every study (Braun 2004, Braun & al. 2013, Cannon 1997, Castañeda-Ruiz & Heredia 2000, Del Olmo & Arnolds 2014, Dingley 1972, Haines 1980, Kirschner & Liu 2014, Medel & Lorea-Hernández 2008, Samuels & Rogerson 1990, Stevenson 1945); unfortunately, few have studied species from the Western Hemisphere. This paper contributes new fern families and genera to the list of ascomycetes hosts: *Dicksoniaceae* (genus *Lophosoria*), *Marattiaceae* (*Marattia*), and *Polypodiaceae* (*Grammitis* and *Pecluma).* This is important since there are few studies on the diversity of fungi on ferns, and most have dealt only with genera of tree ferns in *Cyatheaceae* and *Dicksoniaceae.*

According to the literature surveyed, only seven ascomycete species had previously been registered on ferns from Veracruz. This study adds 18 more records associated with ferns in Mexican cloud forests, bringing the

Table 1. Ascomycete fungi and fern hosts recorded from Mexico

| Species | Host | Reference |
|---|---|---|
| Helotiales | | |
| *Arachnopezizaceae* | | |
| cf. *Arachnopeziza* | *Alsophila firma* | This paper |
| *Dermataceae* | | |
| *Mollisia ventosa** | *Cyathea bicrenata* | This paper |
| *Helotiaceae* | | |
| *Bisporella pteridicola** | *Alsophila firma, Cyathea bicrenata, Pecluma alfredii, Sphaeropteris horrida, Thelypteris* sp. | This paper |
| *Crocicreas quinqueseptatum** | *Cyathea bicrenata* | This paper |

| | | |
|---|---|---|
| *Crocicreas sessilis* | *Cyathea divergens* var. *tuerckheimii* | Samuels & Rogerson 1990 |
| *Cyathicula* sp. | *Cyathea bicrenata* | This paper |
| *Durella macrospora** | *Sticherus palmatus* | This paper |
| *Hyaloscyphaceae* | | |
| *Dasyscyphella dryina** | *Alsophila firma* | This paper |
| *Hamatocanthoscypha helicotricha** | *Cyathea bicrenata, Sticherus palmatus* | This paper |
| *Hyaloscypha fuckelii** | *Alsophila firma* | This paper |
| *Lachnaceae* | | |
| *Lachnum brevipilosum** | *Alsophila firma, Cyathea bicrenata* | This paper |
| *Lachnum fimbriiferum* | *Alsophila firma, Cyathea bicrenata, Cyatheaceae, Dicksonia sellowiana* | Medel & Lorea-Hernández 2008 |
| *Lachnum nudipes ** | *Lophosoria quadripinnata* | This paper |
| *Lachnum oncospermatum* | *Dicksonia sellowiana* | Medel & Lorea-Hernández 2008 |
| *Lachnum pteridophyllum* | *Cyathea divergens var. tuerckheimii, Cyathea* sp., *Dicksonia sellowiana,* ***Dryopteris* sp.**, ***Lophosoria quadripinnata*** | Haines 1980; Medel & Lorea-Hernández 2008 |
| *Lachnum singerianum* | *Alsophila firma, Dicksonia sellowiana* | Medel & Lorea-Hernández 2008 |
| *Lachnum varians* | *Alsophila firma,* ***Cyathea bicrenata, C. divergens* var. *tuerckheimii, Adiantum andicola*** | Haines 1980; Medel & Lorea-Hernández 2008 |
| *Lachnum virgineum* | *Phlebodium aureum* | This paper |
| *Paradiopsidaceae* | | |
| *Dimeriella polypodii* | *Polypodium montigenum, P. madrense* | Samuels & Rogerson 1990 |
| Hypocreales (*Bionectriaceae*) | | |
| *Protocreopsis pertusa** | *Alsophila firma, Marattia laxa* | This paper |
| Orbiliales (*Orbiliaceae*) | | |
| *Orbilia auricolor** | *Cyathea bicrenata, Marattia laxa* | This paper |
| Ostropales | | |
| *Coenogoniaceae* | | |
| *Coenogonium botryosum* | *Adiantum andicola, Grammitis* sp. | This paper |
| *Stictidaceae* | | |
| *Stictis carnea** | *Cyathea bicrenata* | This paper |
| *Stictis radiata** | *Alsophila firma, Cyathea bicrenata,* ***Sphaeropteris horrida, Polypodium* sp.** | This paper |
| Xylariales (*Sporocadaceae*) | | |
| *Seimatosporium tostum* | *Alsophila firma, Cyathea bicrenata.* | This paper |

**Bold face** indicates new hosts for the corresponding fungus

* indicates new fungal records for Mexico

total to 25 ascomycete species distributed among *Helotiales* (20 species), *Hypocreales* (1), *Ostropales* (3), and *Xylariales* (1). Taxonomic diversity of *Ascomycota* reported in similar studies from other regions of the world show a wide diversity of ascomycetes involved in biological interaction with ferns. For example, Del Olmo & Arnolds (2014) reported the primary endophytes to inhabit ferns in Costa Rica belonged to *Dothideomycetes*, *Eurotiomycetes,* and *Sordariomycetes,* while mycosphaerellaceous fungi were more abundant in Taiwan (Kirschner & Liu 2014) and other countries in Asia and Africa (Braun & al. 2013). Only Haines (1980) cited *Helotiales* (*Hyaloscyphaceae* s.l.) as the predominant fungi on tropical ferns, further supported by this study where *Lachnaceae* was the most diverse family represented. To find such diversity of ascomycetes associated with ferns, almost quadrupling the number of species previously known for Mexico, suggests there are several taxa yet to discover. We agree with Kirschner & Liu (2014) that research on ascomycetes growing on ferns is still in its infancy. Additional work is needed to establish the ecology of fern-associated fungi, particularly the recurrence of some taxa on fern hosts.

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